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Development of the Training Use Distribution Model (TUDM) Software

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Introduction

This technical note describes the technology choice and software development of the Training Use Distribution Model (TUDM). TUDM provides the ability to predict the spatial distribution and intensity of off-road maneuver training miles, which in turn provides disturbance data for ecological models, such as the Ecological Dynamics Simulation model (EDYS) (Guertin, Rewerts, and Dubois 1998). TUDM is one of three land conservation models chosen for prototype development in the Land Management System (LMS) Initiative. In keeping with LMS requirements "the user environment was developed based on a combination of marketplace standards (commercial-off-the-shelf browsers, Java, windows, etc.) to ensure its portability and to increase its natural maturation" (Goran et al. 1999).

Approach

TUDM was developed into a software prototype that produces spatial output in a raster Geographic Information System (GIS) format. A Graphical User Interface

(GUI) was linked to a commercial-off-the-shelf (COTS) GIS product. The GIS product and development environment is compatible with technology in use at the LMS testing sites. The testing sites use a combination of the Environmental Systems Research Institute's (ESRI, Redlands, CA) GIS software running on a Windows platform. The choice of ESRI's products and the Windows platform was a function of the model's requirements. TUDM requires grid analysis capabilities for calculating disturbance and intensity values on a 50- by 50-meter cell basis. The only ESRI product capable of performing analysis of this kind is Workstation ARC/INFO 7.2.1, which operates on the Windows NT 4.0 platform. Workstation ARC/INFO allows for GUI and general program development through their Open Development Environment (ODE). In ODE, programs can be developed to communicate with ARC/INFO through command line exchanges. ODE supports Visual Basic, Visual C++, Delphi, and the Power Builder development environments. Of these four environments ESRI provided the greatest support for Visual Basic. Subsequently, Visual Basic 6.0 was chosen for TUDM development.

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Prototype Development

The TUDM software prototype contains three main parts: the user interface (front-end), the processing architecture (backend), and the help system.

User Interface

The user interface was developed with two approaches in mind. The first approach aligned itself closely with the LMS initiative. In this context a user interface or front-end GUI is not required. The LMS initiative will use a universal interface requiring only the TUDM backend and help system.

The second approach required a user interface in the event that TUDM is deployed as a stand-alone product. Interface design in this context assumes that the user is familiar with the Windows operating systems and has a basic understanding of ESRI GIS products and their uses. To accommodate both approaches, object-oriented programming principles were strongly adhered to, keeping the front-end and backend completely separated. In this way, code reusability can be effectively leveraged for either the LMS initiative or stand-alone deployment.

The stand-alone interface has a Windows feel and used list boxes, radio buttons, and check boxes to solicit model parameter inputs. Help and tutorials are readily available via the click of a "Help" button or by pressing the F1 function key. To view map outputs, a grid Object Linking and Embedding Custom Control (OCX), supplied in ARC/INFO ODE, is placed on a Visual Basic form. Through the use of Visual Basic code, command line instructions are sent to ARC/INFO to display output maps in the grid OCX.

Processing Architecture

The architecture consisted of developing the classes and class relationships

(backend), which formed the template for storing information about training exercises and training scenarios. The classes contain methods and properties, which receive input from the interface and process these inputs into desired outputs. TUDM outputs include map layers representing average tracking intensity as well as three categories of increasing tracking intensity on a 50- by 50-meter cell basis. Unless otherwise specified, all output maps are produced in ARC/INFO grid format, but can optionally be produced as GRASS ASCII for input to other models (e.g., EDYS).

Help System

The help system, written in the Hypertext Markup Language (HTML), was developed in Microsoft HTML Help Workshop. The help system consists of a tree structure of topics and content pages that are written in HTML. Each of the pages is viewed using the Microsoft Internet Explorer web browser. A completed set of content pages and topics are compiled into a help project file that can then be linked to TUDM through the program's properties. Help can be invoked by pressing the F1 Key or by clicking on a "Help" button or menu item. Clicking either option elicits a Windows Application Programming Interface (API) call, which activates the help system and Internet Explorer.

Current Status

TUDM is currently entering its in-house testing phase. During this time TUDM will be tested by users and will be interfaced with EDYS in an attempt to test model-to-model interaction. Following successful completion of this testing, TUDM will be available for integration into the LMS Initiative.

Point of Contact

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